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PROCUREMENT SPECIFICATION

FOR

AUTOMATIC DIRECTION FINDER SET

(U)

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PS 68-870028

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(U) 3. REQUIREMENTS. The equipment specified herein shall meet the requirements of this specification, including requirements covering all operating, non-operating, and storage conditions. The equipment shall meet performance and all other requirements of this specification while installed in a complete airplane, during both ground and airborne operations, provided the environment in the airplane is no more stringent than that specified herein.

(U) 3.1 Item definition. The Automatic Direction Finder (ADF) Set covered by this specification consists of two units; a cavity-backed disc-type antenna and an Electronic Control Amplifier unit. The ADF set shall be designed and constructed to operate in conjunction with the UHF receivers and associated display equipment (which are not a part of this specification) to provide a display of aircraft bearing with respect to a transmitter operating on the selected frequency within the 225.0 through 399.95 megahertz (MHz) frequency band.

MOA
PS-18

(U) 3.1.1 Interface definition. The equipment covered herein shall be compatible with the associated equipment listed below and shall meet all requirements when installed in the F-15 airplane and operated in conjunction with the associated equipment listed below. Such associated equipment is not to be supplied as part of the equipment covered by this specification. The equipment shall not be damaged by operation of the associated equipment when in any mode of operating (including OFF mode); nor shall the equipment be damaged in any mode of operation when any or all of the associated equipment is partly or wholly disconnected from the equipment. The performance of the associated equipment shall in no way be degraded, or interfered with, by operation of the equipment covered herein.

List of associated equipment.

<u>Number</u>	<u>Name</u>
PS 68-870026	UHF Receiver Transmitter
PS 68-870064	UHF Comm Receiver
PS 68-870063	Horizontal Situation Indicator Set
PS 68-870055	Integrated CNI Control Panel
DS 68-870072	BIT Control/Display Panel
DS 68-870073	Avionic Status Panel
DS 68-870074	UHF Antenna Selector

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ADF
0009

(U) 3.2 Characteristics.

(U) 3.2.1 Performance.

(U) 3.2.1.1 Functional requirements:

(U) 3.2.1.1.1 Sensitivity. The ADF set, when operating with the associated equipment of Paragraph 3.1.1 shall provide the direction finding performance specified herein when the antenna is subjected to vertically polarized rf fields in the frequency range of 225 to 400 MHz with field strengths from 50 microvolts/meter to 0.3 v/meter and modulation percentages up to 30 percent at 1000 Hz. With the above rf input signal strength, the ADF set shall provide an rf output signal of not less than 5 microvolts (open circuit) for use at the antenna input of the UHF receivers.

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PS-3

The handwritten note at the top of page 6 is as follows:

"Service and standard conditions when mounted on a ground flat plane. The accuracy shall be determined by measuring the difference between the mean indicated and true bearing at 36 equally spaced points around the azimuth and then performing an RMS calculation of the 36 different values. In addition, the maximum differences between the mean indicated and the true bearing at any heading within + or - 15 degrees of 0 degrees (fwd direction) shall be less than 5 degrees."

service and standard conditions when mounted on a flat ground plane. The accuracy shall be determined by measuring the difference between the mean indicated and true bearing at 36 equally spaced points around the azimuth and performing an RMS calculation of the 36 difference values. PS 68-870028 in addition the maximum difference between the mean indicated and true bearing at any heading within $\pm 15^\circ$ of 0 degrees (true direction) shall be less than 5 degrees

- (U) 3.2.1.1.2 ADF modulation. The incoming UHF rf signal being used for ADF shall be amplitude modulated at least 30% by the rotation of the ADF antenna at a frequency of 10 KHz \pm 2.5 KHz.
- (U) 3.2.1.1.3 Audio input impedance. The ADF set audio circuitry shall present a load impedance of at least 20 K ohms to the Integrated CNI control panel output circuitry. (The audio output circuitry frequency response of the associated Integrated CNI control panel is 70 to 7000 Hz \pm 4 dB). RCP ADF 0009
- (U) 3.2.1.1.4 Audio input level. The ADF set shall operate within specification with an input audio level as low as 0.1 volt rms from the associated Integrated CNI control panel. RCP ADF 0009
- (U) 3.2.1.1.5 Accuracy. The rms value of the differences between the indicated readings and the true bearing at 36 equally spaced points around the azimuth shall not exceed 2.5° under environmental service and standard conditions and the 4.2.1.4 acceptance test, when mounted on a ground plane. The accuracy requirements shall apply when the ADF is operated with receivers with an overall envelope delay of 30 ± 12 us or 50 ± 12 us. WIDE BAND MOA PS-4 MOA PS-5
- (U) 3.2.1.1.6 Overshoot. When seeking a bearing, the output shall not overshoot the ultimate bearing by more than 5° and shall be within tolerances specified in 3.2.1.1.5 within three seconds.
- (U) 3.2.1.1.7 Hunting. The hunting of the indicator shall not exceed 1° rms for the signal strength specified in 3.2.1.1.1. Hunting is defined as the repeated momentary deviation of the digital output from the correct heading. MOA PS-6
- (U) 3.2.1.1.8 Lag. The bearing output shall not lag the actual bearing by more than 2.5° when the actual bearing is changing at a rate of 30° per second or greater. For rates less than 30° per second the bearing lag shall be less than 1.5° .
- (U) 3.2.1.1.9 Speed of response. Under all conditions the equipment shall be capable of seeking out a new bearing at a rate of not less than 360° per second.
- (U) 3.2.1.1.10 Warm up. The warm up period shall not exceed 10 seconds.
- (U) 3.2.1.1.11 Outputs.
- (U) 3.2.1.1.11.1 Digital output to HSI. The ADF shall have a digital output with a range of 0 degrees to 360 degrees, slew rate of 60 degrees per second, update rate of 20 updates per second and 16 serial bits employing bi-phase coding. A signal in phase with the clock reference shall represent a logical one and a signal out of phase with the clock will represent a logical zero. Transmitted data signal levels shall be $+5(+1)$ and $-5(+1)$ volt square waves with rise and fall times in the range of 150 to 500 nanoseconds. The clock frequency shall be 100 kHz $\pm 1\%$. The clock and a Data Initiate signal will be transmitted to the ADF over shielded separate twisted pair transmission lines having a characteristic

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PS 68-870028

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(U) 3.2.1.1.11.1 (Continued).

impedance of 68 ohms. Each line will be balanced to ground and both the receiving and transmitting ends will be transformer coupled. A center tap on the line side of each transformer will be grounded, as will each end of the transmission line shield. The receiver and transmitter will present a balanced, 68(+10%) ohm line-to-line impedance that is less than 10% reactive at the clock frequency. The data word shall be expressed in the True Binary/Two's Complement Number system where the Most Significant Bit is -180° and the Least Significant Bit is as specified in Figure 8. The Data Initiate signal will precede the start of data by approximately one clock period.

MOA
PS-14
RCP
ADF
0009
MOA
PS-7

- (U) 3.2.1.1.11.2 Antenna Connections. The ADF shall have a coaxial switch incorporated and three R.F. connections shall be available on the control amplifier to allow connection of the ADF antenna to either a UHF receiver or a UHF receiver/transmitter. The common coaxial connection (ADF antenna) shall be fed through a preamplifier such that all ADF antenna signals are amplified before being routed to either the receiver or R/T. Completion of a grounding circuit external to the ADF will energize the coaxial switch.

(U) 3.2.1.1.12 Inputs.

- (U) 3.2.1.1.12.1 UHF receiver audio. The ADF set shall accept an audio signal from the Integrated CNI control panel when the ADF is operating. The audio will be transmitted via a twisted shielded pair.

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ADF
0009

- (U) 3.2.1.1.12.2 Coaxial relay ground. The ADF set shall be configured to allow the antenna coax switch (Ref. Paragraph 3.2.1.1.11.2) to be energized upon application of an external ground.

(U) 3.2.1.2 Unit requirements.

- (U) 3.2.1.2.1 Antenna. The antenna component shall consist of a fixed array using solid state switching techniques to lobe the pattern described in 3.2.1.2.1.1 through a 360° area.

- (U) 3.2.1.2.1.1 Field pattern. The antenna field pattern shall approximate a cardioid shape which shall remain constant when lobed through 360°. This lobing of the pattern causes the receiver rf output to be amplitude modulated. The resulting demodulated signal shall be compared in phase with the reference switching signal within the signal processor to provide the bearing information.

- (U) 3.2.1.2.1.2 Antenna gain. The minimum gain of the antenna in the direction of maximum sensitivity shall not be less than 17 dB below that of a lossless matched quarter wavelength stub at any frequency within the 225 to 400 MHz range.

PS 68-370028

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- (U) 3.2.1.2.1.3 VSWR. The VSWR of the antenna under normal switching operation shall not exceed 2.0:1 when terminated in the nominal 52 ohm impedance.
- (U) 3.2.1.2.2 Electronic control amplifier unit. The Electronic Control Amplifier unit shall generate the antenna rotation pattern and compare the audio output signal strength from the Integrated CNI control panel with the antenna direction. The resulting demodulated signal shall be compared in phase with the reference switching signal within the signal processor to provide the bearing information. RCP
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- (U) 3.2.1.2.3 Deleted. MCA
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- (U) 3.2.1.3 Useful life. The equipment shall have a useful life of not less than 10 years under any combination of operating and storage life, where the operational service life has not been exceeded.
- (U) 3.2.1.3.1 Operational service life. The equipment shall have an operational service life of not less than 6,000 hours under any natural combination of environmental conditions specified herein. Operational service life is defined as the total operating time between the start of operation and wear out. Wear out is defined as the point where overhaul or repair cost exceeds one-half of the replacement cost of equipment.
- (U) 3.2.1.3.2 Storage. The equipment shall meet all requirements of this specification without component or part replacement, adjustment, or maintenance action after being in storage for a minimum of 18 months.
- (U) 3.2.1.4 Service conditions - electrical. Electrical service conditions shall be in accordance with Paragraph 3.2.23 of MIL-E-5400. The equipment shall meet all specified requirements of MIL-STD-704 for the types of power specified herein, and shall give specified performance when supplied with electrical power having characteristics and limits as defined in MIL-STD-704 Category B. The power input required shall not exceed 20 watts at 28 volts dc. The ADF set shall perform within specification limits when supplied with emergency electrical power per MIL-STD-704, Notice 1. MCA
PS-9
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- (U) 3.2.1.4.1 Electrical power interruptions. Momentary power interruptions to the equipment will be experienced when external primary power is switched to aircraft power or when switching from one aircraft power bus to another. The equipment shall meet the performance requirements of this specification after such momentary power interruptions have been experienced. As a minimum, the equipment shall be designed to return within specified performance within five seconds after a power interruption of up to 100 milliseconds, with up to 500 milliseconds being a design objective. The peak transient degradation existing at the output signals within one second of cessation of power interruption shall not exceed twice the tolerance specified for the equipment under continuous power operation.
- (U) 3.2.1.5 Thermal requirements. The thermal requirements of the equipment shall be in accordance with Paragraph 3.2.5 of MIL-E-5400 except as modified herein.
- (U) 3.2.1.5.1 Heat dissipation. The heat dissipation of the ADF set shall not exceed 20 watts. MCA
PS-10

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PS 68-870028

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+0.08789625
 +0.17578125
 +0.3515625
 +0.703125
 +1.406250
 +2.812500
 +5.625000
 +11.250000
 +22.500000
 +45.000000
 +90.000000
 -180.000000

Figure 8 BIT Values, Degrees

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